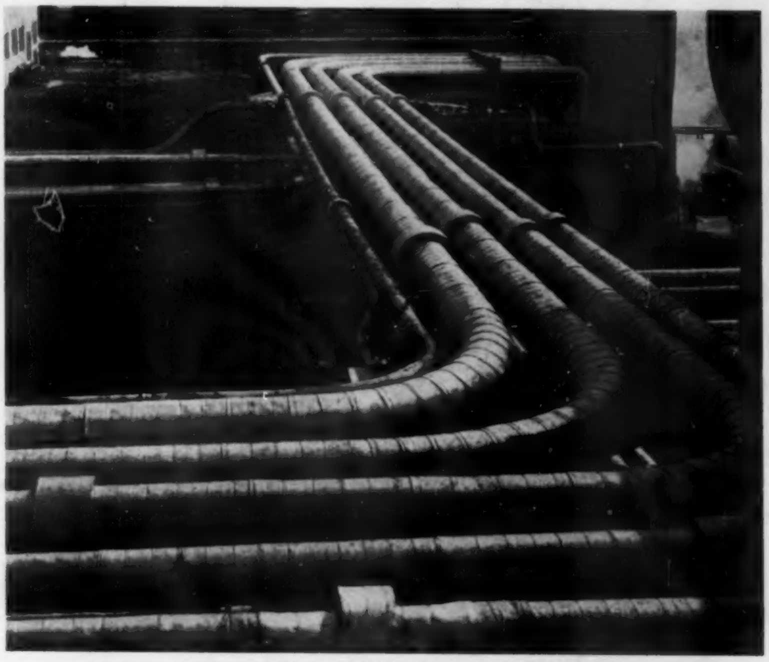
The Science Teacher

FEBRUARY



PIPES IN THE PROPANE PLANT, BAYTOWN REFINERY.
Credit: Standard Oil Co. (N. J.) Photo by Corsini.

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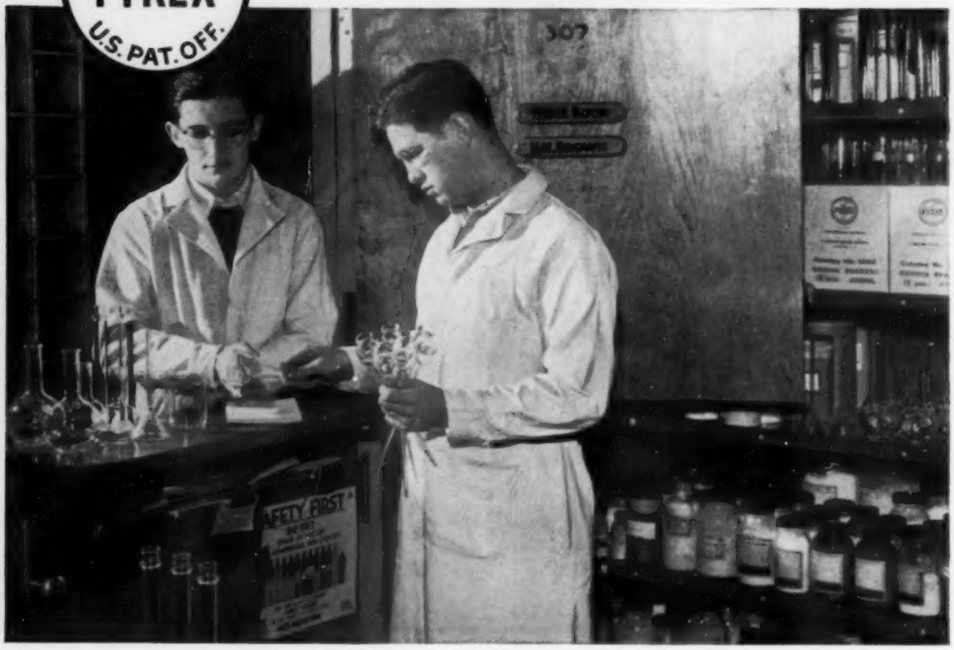

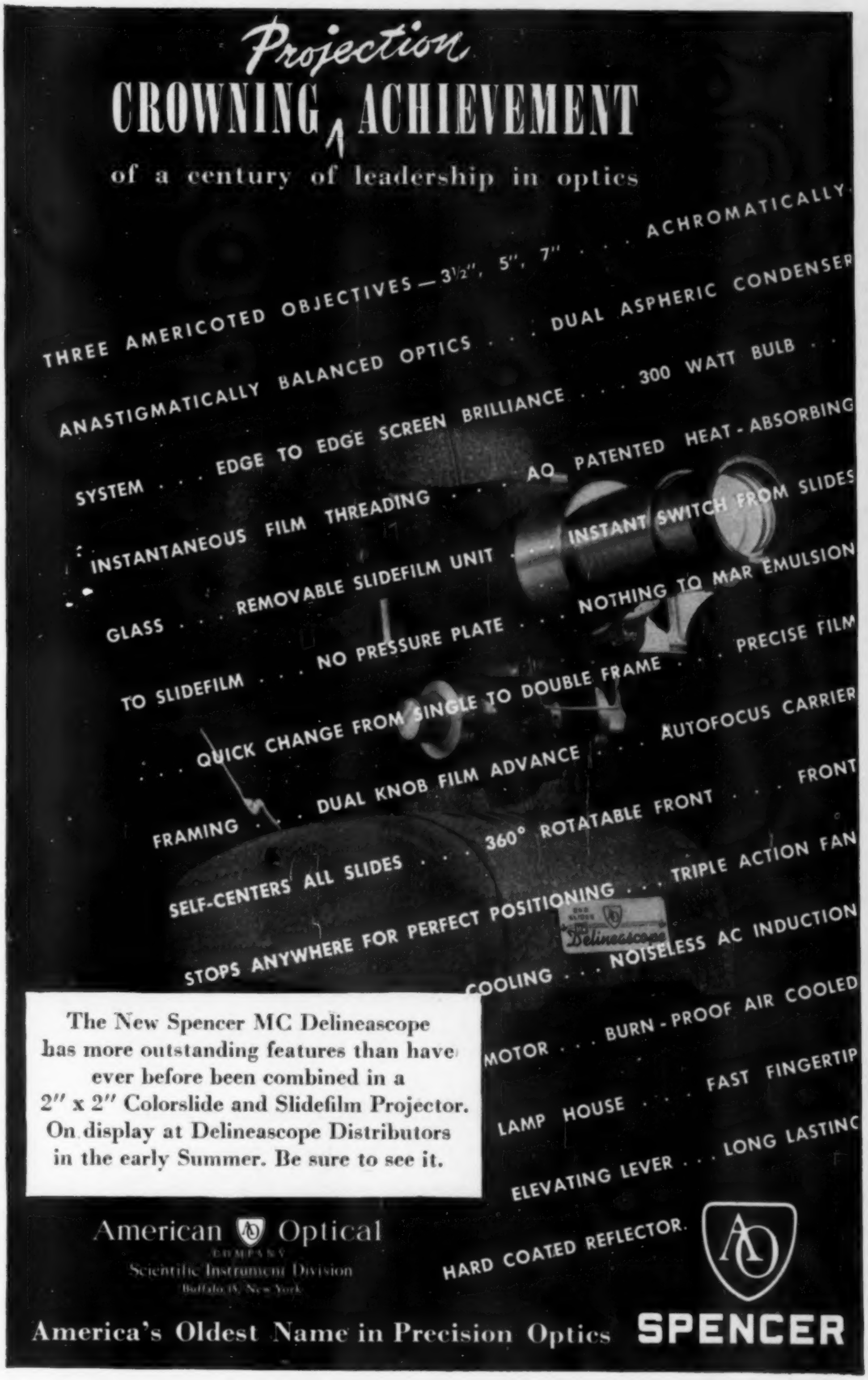
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The Science Teacher

VOLUME XVI — FEBRUARY, 1949 — NUMBER 1

Emphases for Intergroup Education in Secondary School Science

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Phoenix, Arizona

THE TEACHER, whatever his subject field, first of all assumes personal responsibility for the improvement of intergroup relationships in all of his own associations with individuals and groups.

The teacher examines his own thinking conscientiously. What stereotypes may he still hold? What experience that he should have had to broaden his understanding has he thus far missed?

He plans consciously the education of his own immediate family and particularly of his children to see that they have broadening intergroup experiences and are able to grow toward consistency in thought and action.

He assumes personal responsibility to help his friends and professional associates enlarge their understanding through reading and direct experience.

He carries his convictions into dealings with clubs and organizations to which he belongs, seeks their support for resolutions and action that will tend to encourage better relationships and discourage segregation and discrimination, and helps to plan programs and experiences that will broaden the understanding of club and organization members.

He carries his convictions into his business dealings to find out the policy of firms he patronizes with regard to discrimination and protests discrimination when and where he finds it.

He inquires into the attitudes on segregation and discrimination of candidates for political office and expresses through his party his convictions concerning these matters.

He accepts whatever responsibility he can for speaking and writing in behalf of his convictions.

THE TEACHER, whatever his subject field, deals with both parents and pupils in such a way that the maximum interaction and understanding is possible between individuals and between groups.

The teacher accepts each student on a basis of friendly understanding, without censure for those aspects of the pupil's behavior which may reflect differences in background or upbringing.

He organizes his class so that discussion results in give-and-take among students in addition to two-way give-and-take between student and teacher.

He is conscious of the need for involving all pupils, not just those who are most articulate and energetic, in planning and sharing.

He is aware of the need for appreciation by all pupils within his class.

He provides opportunities for interaction between the members of the parent community as well as between teacher and parent.

IN TEACHING the importance of the use of the scientific method and the changes that have come about in society as a result of its use, the science teacher has an opportunity to indicate the number of areas in present living where superstitions still persist.

The concept of the stereotype can be taught, with activities that will help to sensitize the student to the sources of error in the "thinking" involved.

Students may be encouraged to collect, analyze, and evaluate examples of inadequately based beliefs in the areas of race and heredity.

The class may choose to examine aspects of modern society where conflict and controversy might be lessened by the proper use of the several steps of the scientific method. One such aspect (housing, public health, or segregation) might be examined in some detail, with students attempting to apply the scientific method to analysis and solution of the problem.

WHEN THE science class is dealing with a study of man and his environment, it has an opportunity to become acquainted with the distribution of races and cultures and the influence exerted upon cultural development by many factors in climate, geography, and population movements.

Various sections of the world may be studied in terms of statistical variations in key aspects of climate, such as rainfall and heat, and the differences in culture related to these factors.

The distribution and richness of plant and animal life and other natural resources may be related to the local utilization of the native resources as this use has produced cultural differences and accelerated or impeded cultural change.

Study may indicate that the migration of man since the beginning of time places all theories of race in jeopardy.

NUTRITION may be studied in part as a world problem, with emphasis upon the differences in the way various peoples have made adjustments to their food sources and the way in which world trade has spread the accessibility of the world market to many remote areas.

The contributions of the peoples of the world to types of food and food preparation may be stressed.

The class may study the effect upon the food habits and agricultural economy of scientific developments such as those of George Washington Carver.

Students may be given an opportunity to understand the relation between a low-calory diet, such as is found among the uninformed and impoverished, and low energy output.

Study may be included of the changes found in stature and weight of descendents of ethnic or racial groups that have moved from a barren to a favorable environment.

IN THE STUDY of health, students may become acquainted statistically with the differences between racial and other minorities and the majority in many categories, with emphasis placed upon the reasons for these differences.

Comparison of the rate of incidence for tuberculosis and venereal disease among Negroes and Caucasians may be used to indicate the drastic differences in living conditions.

Housing conditions for slums and other areas will present a similar contrast between the opportunity for decent living that exists in the community at large and among segregated and/or impoverished groups.

Study of hospital facilities in the local community may reveal differences in treatment of majority and minority groups.

Community differences in provision of other health facilities, such as garbage disposal and clinics, may indicate discriminatory practices to be examined in relation to the well-being of both the majority and the deprived groups.

THE STUDY of heredity offers a direct opportunity to clarify scientific findings on the natural equality of all peoples.

If a specific study of race is to be included in the course of study, it may properly come in connection with the study of heredity.

The place that environment and inherited culture play in the education of all individuals may be developed, perhaps in cooperation with the social studies department.

The adaptability of the Negro or other group may provide a theme for tracing adjustments made by a group to many different environments.

The wartime experience of separating white and Negro donations to the Blood Bank may be examined for the scientific baselessness of the separation. *Continued on Page 41*

Science Principles Illustrated by the Work of Luther Burbank

JOHN Y. BEATTY

Crystal Lake, Illinois

LUTHER BURBANK, the world's most versatile plant improver, was born March 7, 1849—so this year is the centenary of his birth. I had the rare privilege of working with him in Santa Rosa, California, for several years beginning in 1911. It seems to me that his accomplishments and the principles he followed make it important for science teachers to use information about his work to illustrate various principles in biology. He introduced more than eight hundred new varieties of plants. This is more than any other man has introduced before or since.

Still, Luther Burbank was not a scientist. As a matter of fact, his education was meager. He did not attend high school. He did not attend college. But he learned from reading and by talking with scientists how Nature can be encouraged to produce new, useful varieties of plants.

His first production was the Burbank potato which he obtained in a way that any boy or girl could secure a new variety of potato. He found a seed ball on a potato plant in his garden in Massachusetts, and in the seed ball were twenty-nine seeds. He planted these, and from one of those seeds the new variety proved to be more useful than any other variety then available. This Burbank potato is now grown on thousands of acres in the northwestern states and the income from it amounts to over seventeen million dollars a year.

MR. BURBANK introduced one hundred and thirteen new varieties of plums and prunes. Twenty of these varieties are still widely planted throughout the United States and other countries. Ten of them are standard shipping plum varieties in California, South Africa, Argentina, and Australia. In California alone, there is a total of twenty-four thousand acres of Burbank plums. Thousands of carloads of fruit are shipped every year from these acres, and the returns to the growers run into the millions of dollars.

All of these new varieties which came from his grounds in Santa Rosa and Sebastopol, California, were produced either by selection of plants which seemed to be better than others growing in wild places or on his own grounds.

Some were produced merely by planting the seeds of plants which do not reproduce true from seeds. For example, practically all of our fruits will give us a new variety when a seed is planted. Any boy or girl can be encouraged to plant the seeds of an apple, orange, or plum, and he can be sure that if he does so, he will get a new variety from each seed. It is true, however, that most of these new varieties will be worthless, but if he will grow thousands, as Luther Burbank did, he may find one or more varieties which are better than what we already have.

When the seeds of those plants which are reproduced by bulbs or tubers are planted, they produce new varieties. Each seed of a dahlia or of a potato will grow into a new kind of dahlia or a new kind of potato.

TO GET A wider variation from those plants which commonly reproduce more or less true from seed, such as beans, beets, onions, peas, and so on, a greater variety from which to select may be obtained by cross pollination. The process of pollenizing plants is comparatively simple; still, there are a number of things to be learned about it.

Pollenizing is accomplished by transferring the pollen from one plant to the pistils of the blossoms on another plant. This sounds very simple, and it is simple in some cases. However, there are times when the pollen and pistils are not ripe at the same time. In that case, crossing is more difficult.

It is also to be remembered that, after pollen has reached the pistil of a flower, that combination cannot be changed. In other words, the pollen first arriving on the end of the sticky pistil quickly begins to grow down

Continued on Page 44

Experiments in Illumination

W. E. MILLER

University of Illinois

Introduction

THE phenomenon by which the intensity of light rays can control the flow of an electric current is known as the photoelectric effect. The instances in which this effect is noticeable can be classified into four groups as follows:

1. The Photovoltaic cell.

Light rays falling on one of the electrodes of a glass enclosed miniature voltaic wet cell will cause an electric potential difference between the electrodes of the cell. This was first reported by the French scientist Becquerel, in the year 1865. Little practical use has been made of this type of cell due mainly to its inherent instability.

2. The Selenium Resistance cell.

The resistance of selenium wire is highly sensitive to light rays, varying inversely with the intensity of the light. This fact gives us the basis for the selenium resistance photocell which appeared in the year 1930. Since this cell is not of the self-generating type, its function is to control the current in an auxiliary circuit containing a battery or other source of electromotive force. This type of photocell did not gain wide acceptance because the selenium resistor cell is very unstable and has a fairly high "dark" current (when all light is excluded) causing continuous drain on the source of e.m.f. with which it is used.

3. The Photoemissive cell.

This cell, commonly called a phototube, is comprised of a large semi-circular cathode sensitized with an alkali-metal such as caesium or sodium, and a slender anode post placed inside an evacuated tube. Light rays, upon striking the sensitized cathode liberate electrons from the cathode surface, which are immediately drawn to the positively charged anode, resulting in an electric current of a few microamperes. Currents of this magnitude were not sufficient to make this type of cell useful until the perfection of the vacuum tube within the past two decades has made it possible to amplify these currents into more usable proportions.

4. The Barrier Layer cell.

Frequently referred to as the dry disc type, this cell is composed of a thin semi-conductor material on a metallic base, such as selenium-on-iron or cuprous oxide-on-copper. Light, striking the outer surface of the semi-conductor, liberates electrons which cannot penetrate the semi-conductor due to its high resistance to current flow in that direction. A potential difference then exists between the metallic disc base and the outside surface of the semi-conductor. A circuit containing a micro-ammeter and contacting these two surfaces, will conduct the resulting current to the microammeter which will give an indication of the intensity of the impinging light beam.

Due to its stability and accuracy, the selenium-on-iron barrier layer cell is usually employed in our modern exposure and foot-candle meters, and is the type cell with which we are concerned in this experiment.

Recommended Equipment

Foot-candle meter without correction filter.

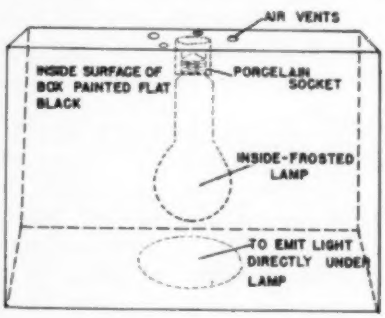
A new (less than 10 hours use) 75 watt inside frosted, 115 volt, incandescent lamp enclosed in a manner similar to that shown in Figure 1.

Yardstick or similar measuring device.

Various other light sources.

Calibration of the Foot-candle Meter

AS IS TRUE with most electrical instruments, the foot-candle meter is subject to definite limitations. Fortunately, it is possible



PLYWOOD OR SIMILAR LIGHT CONSTRUCTION MATERIAL IS SUGGESTED

FIG. 1 RECOMMENDED HOUSING FOR 75 WATT LAMP

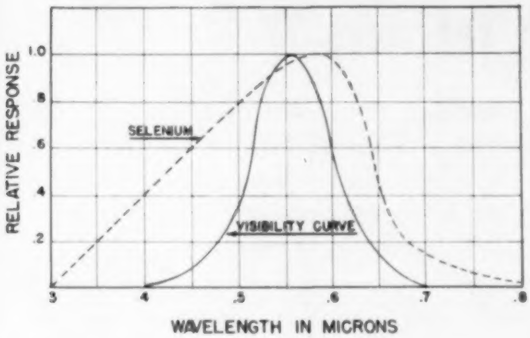


FIG. 2 COMPARISON OF VISIBILITY CURVE OF HUMAN EYE AND SPECTRAL RESPONSE CURVE OF UNCORRECTED SELENIUM BARRIER-LAYER PHOTOCELL

to adjust for these limitations, permitting the use of the foot-candle meter under most circumstances. To make these adjustments, it is necessary to consider the following.

The response curve of the uncorrected photocell to the different wave-lengths of light in the visible spectrum does not correspond to the response of the human eye to these same wave-lengths. A comparison of these response curves is shown in Figure 2. To correct for this difference in response curves, it must be remembered from article one of this series (Levels of Illumination, The Science Teacher, Dec. 1948) that the meter is designed to give an accurate reading of illumination levels when used under a source of light having a 2700° Kelvin[1] color temperature.[2]
The 75 watt lamp recommended above has a 2705° Kelvin color temperature when used at rated voltage, and, therefore, a foot-candle meter should give correct readings when used in conjunction with this source.

When used to measure illumination levels provided by other sources, the reader is referred to Table I and Figure 3 which give the color temperatures of various sources of illumination and the correction factor by which the meter reading must be multiplied.

1—Kelvin temperatures are measured from absolute zero, —273° centigrade.

2—The color temperature of a source of light is the temperature at which a blackbody must be operated to give a color matching that of the source in question.
A blackbody is a temperature radiator of uniform temperature whose radiant flux in all parts of the spectrum is the maximum obtainable from any temperature radiator at the same temperature. *Illuminating Engineering Nomenclature and Photometric Standards*, American Standards Association-Z 7.1-1942, para. 10.055 and 25.030, Illuminating Engineering Society, New York, N. Y.

Table I

Color Temperatures of Various Sources.[3]

Kerosene Lamp	2050 degrees Kelvin
25 watt incandescent lamp	2493 degrees Kelvin
40 watt incandescent lamp	2504 degrees Kelvin
50 watt incandescent lamp	2670 degrees Kelvin
75 watt incandescent lamp	2705 degrees Kelvin
100 watt incandescent lamp	2740 degrees Kelvin
200 watt incandescent lamp	2810 degrees Kelvin
500 watt incandescent lamp	2960 degrees Kelvin
1000 watt incandescent lamp	2990 degrees Kelvin
1500 watt incandescent lamp	3025 degrees Kelvin
40 watt white fluorescent lamp	3500 degrees Kelvin
40 watt blue-white fluorescent lamp	4500 degrees Kelvin
Noon sunlight (direct)	5500-6500 degrees Kelvin
Overcast sky	6000-7000 degrees Kelvin
Clear sky (without direct sunlight)	8000-9000 degrees Kelvin

The illumination resulting from a point source obeys an inverse square law; that is, the illumination in foot-candles is directly proportional to the intensity of the source expressed in candle power[4] and is inversely proportional to the square of the distance from

3—Values given are for rated voltage.

4—The candle is the unit of luminous intensity. The unit used in the United States is a specified fraction of the average horizontal candlepower of a group of 45 carbon-filament lamps preserved at the National Bureau of Standards, when the lamps are operated at specified voltages. This unit is identical, within the limits of uncertainty of measurement, with the International Candle established in 1909 by agreement between the national standardizing laboratories of France, Great Britain, and the United States, and adopted in 1921 by the International Commission on Illumination.
Candlepower is luminous intensity expressed in candles.
Illumination is the density of luminous flux on a surface; it is the quotient of the flux by the area of the surface when the latter is uniformly illuminated. *Illuminating Engineering Nomenclature and Photometric Standards*, American Standards Association, Z 7.1-1942, para. 05.025, 05.030 and 05.035, Illuminating Engineering Society, New York, N. Y.

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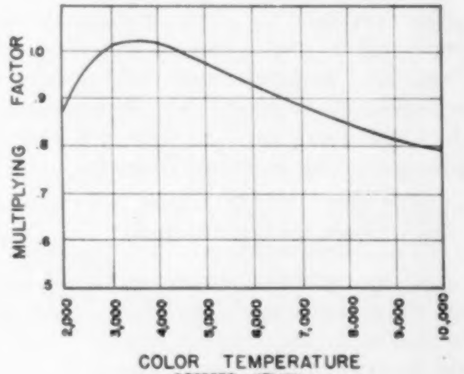

FIG. 3 MULTIPLYING FACTORS TO BE USED WITH SELENIUM BARRIER-LAYER PHOTOCELLS.

Chats With Science Teachers IV

Science and Imagination

HANOR A. WEBB

Secretary, National Science Teachers Association
George Peabody College for Teachers
Nashville, Tennessee

"There are one-story intellects, two-story intellects, three-story intellects with skylights. All fact collectors who have no aim beyond their facts are one-story men. Two-story men compare, reason, generalize, using the labors of fact collectors as well as their own. Three-story men idealize, imagine, predict; their best illumination comes from above, through the skylight."—*Oliver Wendell Holmes* (1809-1894), American physician, philosopher, and poet.

Are you developing three-story intellects in your science classes? Indeed, at what story does *your own* intellect operate?

The core of the "three-story intellect" is undoubtedly its powers of imagination. Do you teach science in ways that encourage the imagination of your students? Do you challenge your own imagination as you study?

Imagination is possessed in varying degrees—from zero to infinity, it seems—by students. Let's give an example. Several years ago hundreds of students, tempted by a modest prize, sent in their caption for a simple picture. An airplane was flying above an ox-cart—so "what is the best title for this picture?" Scores wrote "Ox-cart and Airplane," and showed no imagination by this literal title. Scores wrote "Fast and Slow," "Today and Yesterday," "Two Highways," and similar mild appreciations of figurative expression. The prize was awarded for the title, "Hi, Grandpa!" And if you fail to see how this brief phrase offers a wealth of comparisons between two generations as to the tempo of living, the satisfactions of scientific achievement, and indeed the technology, then your imagination is not of the best!

Teachers, too, are often unimaginative. A certain sober science teacher had no use for poets. To a thoughtful student he pointed out an "absurd inaccuracy" of Shakespeare, in which the Duke of Burgundy describes his hideaway in the Forest of Arden:

"And this our life, exempt from public haunt,
Finds tongues in trees, books in the running brooks,
Sermons in stones, and good in everything."
—William Shakespeare (1564-1616) in *As You Like It.*

Said the teacher: "Everyone should know that the sermons would be in the books, and the stones in the running brooks!" "But," said the student, "we poets understand."

Imagination extends the pleasure derived from science.

"Were nature not beautiful she would not be worth knowing, and life would not be worth living."—*J. H. Poincare* (1854-1912), French scholar.

Naturalists and scientists add to their "joy of the working" in proportion to their appreciation of this beauty. The happy scientist is "he that can draw a charm from rocks, or woods, or weeds, or things that seem all mute." (*Bryan Proctor*, 1787-1874, English poet).

Imagination in science broadens the understanding of mankind.

This understanding is one of the chief objectives of science.

"One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can."
—*William Wordsworth* (1770-1850), English poet.

Of course he who walks through the woods *without imagination* will see only the bark and the briers. He who walks with *imagination only* may see fairies and goblins. But he who walks with *science and imagination* will see the struggles for survival, the brave attempts to bear fruit, "lucky" leaves in the sun and "unlucky" leaves in the shade, the adaptability of youth, the strength of maturity, the dignity yet weakness of age, the final return "to dust." One can go into the woods a worrier, but come out a philosopher.

Imagination linked with scientific knowledge brings higher concepts of a Creator.

". . . Earth's crammed with Heaven,
And every common bush afire with God!
But only he who sees takes off his shoes."
—*Elizabeth Barrett Browning* (1809-1861), English poet.

Science corrects creeds, but it confirms a Cause. A higher faith is required to accept the universal laws of nature than to agree to a program of thinking set by human authority. Said Francis Bacon (1561-1626) of England: "There never was a miracle wrought by God to convert an atheist, because the light of Nature *might* have led him to confess a God." Scientists, more than others, can marvel reverently at the order of nature on scales

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A Survey of State Syllabi for Science

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THE PURPOSE of this article is to present an up-to-date analysis of all the publications prepared by state departments of education for science teachers. The analysis was made for the following reason:

It was desired in view of many requests from classroom teachers for the table developed in an earlier analysis:[1]

1. To incorporate with the materials in the table in the previous report, materials found in more recent state publications for science.
2. To present a table which would be of more use to science teachers than was the previous one.

As a first step, letters were sent to the "Directors of Instructional Supervision" of all of the 48 states, requesting syllabi, courses of instruction, and any other publications prepared by the state departments of education in the field of science. The replies were tabulated and additional letters were sent, until the bulletins available were received or until notification was given that no bulletins for science teachers were available.

The present analysis, therefore, represents all of the state publications for science available on January 1, 1949.

THE analysis was performed in the following manner: All of the publications were examined to determine the major areas of information included in them. Two tables were then compiled, one for the elementary science publications, and one for the secondary science publications. If the states considered grades seven and eight as elementary, the information in such publications was tabulated in the elementary science table, otherwise these grades were considered as secondary.

Each table indicates the state and grade level, or course, for which the publication was prepared, the date of publication, and the areas of information included in them according to the following key:

A. Aims and objectives
B. Suggested units of study
C. Detailed course outlines
D. Reference list for students
E. Reference list for teachers
F. List of equipment and supplies
G. Suggested experiments
H. Suggested learning activities
I. Suggested visual aids
J. Science vocabulary
K. Laboratory layout or floor plans
L. Suggested evaluative techniques
M. Teaching techniques and procedures

IT MUST BE emphasized that the appearance of certain areas in different syllabi does not assume equivalence. In some publications, aims are definitely stated, in others they are implied.

Table I which follows indicates the areas of information presented in the elementary science syllabi analyzed. Also listed are the grades covered and the year of publication.

TABLE I

Alabama (1-6), 1941; A, E.
Arizona (1-8), 1938; A, B, C, D, E, F, G, H, I, L, M.
Florida (1-6), 1947; A, B, C, D, E, F, G, H, I, L, M.
Illinois (1-8), 1947; A, B, C, D, E, F, G, H, I, M.
Iowa (1-8), 1943; A, B, C, D, E, G, H, J, M.
Kansas (1-8), 1947; A, B, C, D, E, F, G, H.
Louisiana (3-7), 1941; A, B, C, D, E, G, H, I, L, M.
Maryland (1-6), 1945; A, B, C, E.
New Hampshire (1-6), 1944; A, B, C, D, E, F, G, H, I, M.
New York (1-6), 1941; A, B, C, D, E, F, G, H, I, M.

*Associate professor of psychology and education.
**Assistant professor of education.
1 Mallinson, George Greisen, "State Publications for Teachers of Science," *School Science and Mathematics, XLVII* (February, 1947), 181-2.

North Carolina (1-7), 1941; A, B, C, D, E, F, G, H, I, L, M.
Ohio (1-6), 1947; A, B, C, D, E, F, G, H.
South Carolina (1-8), 1946; A, B, C, D, E, F, G, H, M.
Tennessee
(1-3), 1944; A, B, C, D, E, G, H, I, M.
(4-6), 1944; A, B, C, D, E, G, H, I, M.
(7-8), 1943; A, B, C, D, E, G, H, I, M.
Utah (1-6), 1946; A, B, C, E, G, H. I.
Vermont (1-8), 1942; A, B, C, D. E, G, H, I.
West Virginia (1-8), 1941; A, B. C, D, E, F. G, H, L, M.

Table II which follows indicates the areas of information presented in the secondary science syllabi analyzed. Also listed is the date of publication.

TABLE II

Florida
General Science, (7-9), 1948; A, B, D, E. F, H, I, L, M.
Biology, 1948; A, B, D, E, F, H, I, L, M.
Chemistry, 1948; A, B, D, E, F. H, I, L, M.
Physics. 1948; A, B, D, E, F, H, I, L, M.
Iowa
Biology, 1932; A, B, D, E, H, L, M.
Chemistry, 1930; A, B, D. E, F, G, H. L, M.
Louisiana
General Science (7-9), 1933; A, B, C.
Massachusetts
General Science, 1930; F.
Biology, 1930; F.
Physics, 1930; F.
Chemistry, 1930; F.
Minnesota
General Science (7-9), 1932; A, B, C, D, E, F, G, H, L, M.
Biology, 1932; A, B, C, D, E, F, G, H, L, M.
Physics, 1932; A, B, C, D, E, F, G, H, L, M.
Chemistry, 1932; A, B, C, D, E, F, G, H, L, M.
Mississippi
Biology, 1946; F, I.
General Science, 1946; F, I.
Chemistry, 1946; F, I.
Missouri
General Science, 1941; A. B. C. D, E. G, H. I, J, L, M.
Biology, 1941; A, B, C, D, E, G, H, I, J, L, M.
Adv. Phys. Sci., 1941; A, B, C, D, E, G, H, I, J, L, M.
Chemistry, 1941; A, B, C, D, E, G, H, I, J, L, M.
Physics, 1941; A, B, C, D, E, G, H, I, J, L, M.
Montana
Biology, 1945; A, B, C, D, E, H, I, M.
Chemistry, 1945; A, B, D, H.
General Science, 1945; A, B, C, D, E, H.
Nevada
General Science, 1934; A, B, D, E, F, L.
Biology, 1934; A, B, D, E, F, L.
Physics, 1934; A, B, D, E, F, L.
Chemistry, 1934; A, B, D, E, F, L.
Elem. Geol. & Minerology, 1934; A, B, D, E, F, L.
New Hampshire
Biology, 1931; A, C, D, E, G, L, M.
Chemistry, 1931; A, C, D, E, G, L, M.
Physics, 1931; A, C, D, E, G, L, M.
New Mexico
Biology, 1946; A, C, D, E, G, H, I, M.
Chemistry, 1946; A, C, D, E, G, H, I, M.
Physics, 1946; A, C, D, E, G, H, I, M.
New York
Chemistry, 1938; A, B, C, D, E, F, G, H, K, L, M.
Physics, 1938; A, B, C, D, E, F, G, H, K, L, M.
Earth Science, 1939; A, B, C, D, E, G, H, K.
General Biology, 1936; A, B, C, D, E, F, G, H, K.
General Science (7-9), 1948; A, B.
Radio, 1941; A, B, C, D, E, F, G, H, I, K.
North Dakota
*General Science 9, 1931; A, B, C, D, E, F, G, H, M.
Biology, 1934; B, C, D, E, H.
Oregon
General Science, 1937; A, B, D, E, F, G, H, I, L, M.
Biology, 1937; A, B, D, E, F, G, H, I, L, M.
Physics, 1937; A, B, D, E, F, G, H. I, L, M.
Chemistry, 1937; A, B, D, E, F, G, H, I, L, M.
Pennsylvania
General Science, (7-9), 1933; A, B, C, D, E, F, G, H, I, J, M.
South Carolina
General Science, 1946; A, B, D, E, F, G, H, I.

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Ammonium Oxalate as a Catalytic Oxidizer

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AMONG the innumerable chemical reactions known, there are many oxidations which are surprising to a beginning student. One of these is the interaction of two *oxidizing agents*, with the consequent reduction of one of them. An example of this type is:

$$(1)\quad 5H_2\overset{2-}{O_2} + 2K\overset{7+}{Mn}O_4 + 3H_2SO_4 \rightarrow$$
$$K_2SO_4 + 2\overset{2+}{Mn}SO_4 + 8H_2O + 5\overset{o}{O_2}$$

The beginner would suppose that no reaction should take place because he would expect to recognize one component as a usual oxidizing agent and the other as a usual reducing agent. In the case cited above, both components are commonly oxidizing agents. A second type of oxidation which surprises the beginner is the interaction of *two reducing agents*, with the consequent oxidation of one. An example of this type is:

$$(2)\quad \overset{4+}{S}O_2 + 2H_2\overset{2-}{S} \rightarrow 2H_2O + 3\overset{o}{S}$$

The beginner is likewise puzzled by this reaction, as he recognizes both of these components as reducing agents, and therefore expects no reaction.

Probably the greatest surprise comes from discovering that one and the same compound can act as both oxidizing and reducing agent, the reaction being well named "auto-oxidation" or self-oxidation.

$$(3)\quad \overset{3-}{N}H_4\overset{3+}{N}O_2 \rightarrow \overset{o}{N_2} + 2H_2O$$

THAT auto-oxidation is capable of taking place, even in the presence of a reducing agent, is demonstrated by the following evidence, gathered while making preliminary studies on sodium manganate, which were to be followed by some experiments in electrolysis.

Five grams of sodium hydroxide is melted in an iron crucible by means of a Bunsen flame. Now five grams of powdered manganese dioxide are added, with constant stirring and the mixture heated gently until effervescence stops. A large iron nail makes a good stirring-rod for this purpose. If no iron crucible is available, a porcelain evaporating dish will do, although it may require a blast-lamp and bellows to melt the sodium hydroxide. Care should be taken to see that the operator's head is not too close to the crucible, as spattering takes place. The process is otherwise quite safe. The equation is as follows:

$$(4)\quad 2\overset{4+}{Mn}O_2 + 4NaOH + \overset{o}{O_2} \rightarrow$$
$$2Na_2\overset{6+}{Mn}O_4 \quad 2H_2\overset{2-}{O}$$

When the crucible is cold, it is set into a beaker and the crucible is filled with distilled water. By means of a stirring rod, the melted material is broken up and stirred until dissolved. After about ten minutes, the green solution of sodium manganate (Na_2MnO_4) thus formed is poured into a 250 ml bottle and the operation repeated until about 125 ml of the solution has been collected. The solution is allowed to settle for about 30 minutes and the clear liquid carefully poured off.[1] Its pH, as determined by "Hydrion Paper," is eleven.

If 2.5 ml of this sodium manganate solution is mixed with 15 ml of distilled water and then 2.5 ml of saturated ammonium oxalate solution is added (the pH now becomes eight[2]), the green solution becomes red, suggesting the formation of sodium permanganate ($NaMnO_4$), the valence of the manganese rising from 6+ to 7+. The reaction takes place at 1°C as readily as it does at room temperature. If this red is truly caused by the presence of permanganate ion, then it

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1—The reaction does not go to completion, some MnO_2 remaining undissolved, thus making it necessary to wait for a time before decanting the clear solution.

2—When checked by means of a Beckman pH meter, the pH of these solutions were found to be as follows: before addition of saturated ammonium oxalate, 11.3, after addition, 9.25. Since the pH of the ammonium oxalate solution is 6.3, i s acidity does not seem sufficiently high to be the cause of the fall in pH from 11.3 to 9.25, especially since equation 5 indicates that the alkalinity, far from falling, should rise, due to the formation of NaOH. Since the addition of 2.5 ml of the ammonium oxalate solution to 2.5 ml of a sodium hydroxide solution containing an amount of the latter equivalent to that represented by the aliquot of the green manganate solution lowered the pH only 0.1 unit, i.e. from 11.3 to 11.2, a possible explanation for this decrease in pH seems to be the presence of the compounds of manganese, which may somehow act as a buffer.

would seem that we have here the greatest surprise of all, namely the oxidation by a reducing agent (ammonium oxalate) of a substance which may be regarded normally as an oxidizing agent, sodium manganate, and we have thus turned the tables on oxidizing agents, the oxidizer becoming the reducer and the reducer becoming the oxidizer.

SINCE the theory that the ammonium oxalate is, in this case, an oxidizing agent seemed too extravagant to believe, the thought occurred that it might be behaving as a catalyst. If that were the case, the manganese in the sodium manganate (valence 6+) must have undergone auto-oxidation, part of it being oxidized to permanganate (valence 7+) and part being reduced to a lower valence—perhaps the dioxide (valence 4+)—according to the following equation:

$$(5)\quad 3Na_2\overset{6+}{Mn}O_4 + 2H_2O \rightarrow$$

$$2Na\overset{7+}{Mn}O_4 + \overset{4+}{Mn}O_2 + 4NaOH$$

If this were so, the oxide, being insoluble, would show up either as a precipitate, or in colloidal suspension. The latter proved to be the case, and was verified by the following experiments:

1. Since electrolytes discharge colloids, a few pellets of sodium hydroxide were added to the red solution (i.e. ammonium oxalate plus green Na_2MnO_4 solution) and the mixture shaken until the sodium hydroxide was dissolved. After about 15 minutes, a brown flocculence appeared at the top (oxide of manganese) and the red changed to the true permanganate color because the latter was no longer affected by the color of the brown suspension (see No. 3 below).

2. When a beam of light was focused upon another sample of the red mixture in a dark room, a Tyndall cone was obtained.[1]

3. The red color resulting when ammonium oxalate solution is added to sodium manganate solution is not the purplish red of permanganate, but the red resembling that of ferric thiocyanate. That the permanganate ion was probably present, however, and was "discolored" by the suspended oxide of manganese was proved by making a dilute solution of potassium permanganate and adding to it a few drops of a mixture of manganese sulfate and ammonium hydroxide. (This produces colloidal oxide of manganese). The color immediately changed from the purplish red of permanganate to the same "ferric thiocyanate" color mentioned above.

THE interaction of oxalate and permanganate in acid medium is thoroughly understood and widely used as an analytical method. No reference was found in the literature consulted concerning the interaction of these substances in alkaline medium, as discussed in this paper.

Views on the phenomenon of oxidation-reduction have undergone quite a change with the advance of time. At one time it seemed possible to classify some chemical compounds as oxidizers and others as reducers. Yet a glance at equation 2 above will show that SO_2, a common *reducing agent*, can be an *oxidizing agent* towards the sulfur of H_2S. Furthermore, ability to oxidize may vary from the feeble powers of potassium ferricyanide to the great powers of nitric acid. Oxidation-reduction is a relative term and the agents which bring the changes about should be thought of as distributed along a scale, not as comprising two distinct groups.

1—The apparatus used is the Abrahams-Dubner Tyndallometer, described in J. Chem. Educ. *20, 2,* (Feb., 1943).

John Scott Award

Dr. Merle A. Tuve, Director of the Department of Terrestrial Magnetism at Carnegie Institution, Washington, D. C., received the John Scott Award at Girard College, Philadelphia, December 15, 1948 for his outstanding contribution to the development of the proximity fuse during World War II. Former well-known recipients of this award include Madame Curie, Thomas A. Edison, Guglielmo Marconi, Lee DeForest, and Dr. Irving Langmuir.

Nurses Needed

A nationwide Army nurse procurement program has been put into effect because of the great need for nurses to enter the military service in sufficient numbers to give adequate nursing care to the new inductees. One estimate indicated that 3,800 nurses would be needed by June 30, 1949.

This and That

NORMAN R. D. JONES
President, National Science Teachers Association

President's Report

The Cooperative Program of the Science Teaching Societies of the A.A.A.S. held at Washington, D. C., December 27-30, 1948, is now history. Judging from the many fine comments in the correspondence flowing across my desk, it was a great success. A fine program, relatively good attendance, etc., made those responsible for the various items feel that the time and energy spent was well worth while. Congratulations to each of you for your part in making our meeting a success.

The board of director's meetings had many items of business to handle. It was gratifying to note that 24 of the 26 members were present. Extra copies (while the supply lasts) of the minutes of the business sessions may be had, if you so request it from our executive secretary, Mr. Robert H. Carleton.

Many members "sat-in" with us at our board of directors meetings and expressed appreciation for the opportunity of gaining an insight into the many matters handled in the two evenings set aside for this purpose.

Student Memberships

In this column in the December Science Teacher mention was made of schools taking advantage of the $1.00 membership for prospective science teachers.

Word comes that Dr. Ralph Powers of Teachers College, Columbia University, sent in 49 memberships from his science students.

Affiliates

Welcome to the Westchester State College Science Club, an organization of prospective teachers. Mr. Armand De Sanctis is president of this group and Dr. Robert Gordon, an N.S.T.A. Area Director for that part of Pennsylvania, is its sponsor. Dr. Gordon, Mr. De Sanctis and several students attended our recent Washington program and board of directors meeting. Recently 18 individual student memberships to N.S.T.A. were received from them.

Are there other such groups among our Teachers' Colleges? If not, it may be that such organizations could be formed.

Through an oversight (our apologies offered) the Association of Laboratory Assistants, New York City, was inadvertently omitted from the published list of our affiliates.

Many fine meetings of affiliated groups have been reported. If we knew about them early enough, we would be glad to carry an item on the meetings.

News

Our most distant members in attendance at the Washington meeting were from California—Mr. Adrian Gentry of San Diego, Mrs. Blanche Bobbit of Los Angeles and Mr. Bayard Buckham of Oakland.

Mr. Borge Michelson, 19 Avenue Kleber, Paris XVI, a UNESCO science member, was in attendance at our Christmas meeting.

Dr. J. S. Richardson and Dr. G. P. Cahoon of Ohio State University are setting a record for continuous meeting after meeting attendance. It is always a pleasure to have them present.

Greetings and good wishes for the organization have been received recently from Sr. Lebrón Ortez, past president of our affiliate, the Puerto Rico Science Teachers Association; Mr. F. Daniels, science supervisor of the Malayan Schools; and Roy W. Stanhope, head of science department of the Maitland Boys School in New South Wales, Australia.

Membership

It is gratifying that we have already surpassed last year's membership. We are still short of our goal, however. *Have you secured* a couple of N.S.T.A. members (new or renewal) for this year yet? Your help to attain our goal will be appreciated.

Affiliation Voted

N.S.T.A., having cooperated for some time in the work of the National Society for Medical Research, voted affiliation with this society at its recent meeting. The purpose of the so-

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Audio-Visual Aids

Edited by CHARLES R. CRAKES

The editor of this department will attempt to bring before the readers of this publication the latest articles written by science teachers who are making effective use of various forms of audio-visual teaching materials. He will also endeavor to present a cross-section of educational opinions on audio-visual aids he may gather in travelling about North America.

Dr. Milton O. Pella here presents one of the most interesting and helpful articles on Audio Visual Aids in Teaching Science carried in this journal.

Dr. Pella earned the B. A. degree at Milwaukee State Teachers College and the M. S. degree and the Ph.D. degree at the University of Wisconsin.

He now serves at the University of Wisconsin as lecturer on methods of teaching science in the elementary and secondary schools.—C. R. Crakes.

Audio-Visual Aids in Teaching Science

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THE BELIEF that sensory experience is the foundation of all intellectual activity is shared by many. If this statement or belief is true, then all intellectual activity is dependent upon sense perceptions. Sense perception involves the stimulation of the sensory receptors. Experiences are received by the pupil through his sensory apparatus; he sees, he feels, he smells, he hears, and he tastes. These are the paths over which all stimuli reach the learner. They are the connection between the organism and its environment.

Experience is gained by human beings through direct contact with objects or phenomena, pictures of objects or phenomena, and oral or written symbols. Oral or written symbols are interpreted by the learner in terms of his past experience. It is readily noted that learning through the use of these symbols alone results to a large degree in verbalism rather than functional understanding. If oral and written symbols are to be of value in learning in science, they are to be accompanied by other sensory experiences which serve as a basis for their interpretation. Thinking is carried on by the use of symbols or words which represent objects, actions, or concepts. Words or symbols are generally meaningless unless based on concrete experience.

ONE OF THE objectives of science education is: To develop a functional understanding of certain concepts, facts and pripnciples. The realization of this objective requires that the concepts to be presented be defined and that all experiences provided contribute to the development of the defined concepts. Basic to the functional understanding of any concept, fact, or principle is experience.

In the teaching of science several methods have been employed. These have been described as the textbook method, lecture method, demonstration method, and laboratory method. The use of any one method exclusive of all others is of little value. All methods must be employed in their appropriate places if learning is to result.

Audio-visual instructional materials have been added to the above methods of instruction. The use of audio-visual materials involves the presentation of knowledge to be gained through the eye. Such instruction involves not only motion pictures but also objects, models, charts, graphs, lantern slides, field trips, film strips, microscopes, telescopes and specimens.

Audio-visual instructional materials are not ends in themselves, but rather are means to an end. Audio-visual aids are tools of instruction. Each type of visual instructional ma-

terial properly used in the most appropriate places makes for more efficient learning.

An example of the use of audio-visual aids in teaching a unit on light in a junior high school science class is given here to illustrate what is meant by their proper use and appropriate place.

CONCEPTS or understandings concerning light sources, refraction, reflection, transmission of light, opaque, transparent and translucent substances may be easily demonstrated. The teacher may perform the demonstrations and the pupils tell or observe the results. This is commonly referred to as the silent demonstration. In many cases it is desirable to have each pupil supplied with an outline directing his observations. A discussion of the observations is carried on after the demonstration.

Concepts concerning the transmission of light through other media, shadows, lenses, mirrors, telescopes, microscopes, real and virtual images, and the nature of light are most effectively developed through individual laboratory experiences. The individual laboratory activities are to be properly directed through the provision of instructions developed by the teacher or with instructions developed cooperatively by pupil and teacher. The pupil will record his observations and the results will be discussed at the end of the laboratory period. During this laboratory period great strides can be made in developing good techniques. It is always more advisable to help pupils develop the correct techniques the first time, since it is common knowledge that it is easier to form a new habit than to break an old one.

Concepts concerning the nature of color are not so easily demonstrated, so other visual aids are to be used. During some one laboratory period or demonstration period the pupils have, or at any rate, have seen a prism used to break up white light into its primary colors. The pupils know that white light is made of violet, indigo, blue, green, yellow, orange, and red.

THE MEANING of color is introduced at this time and a sound motion picture is to be used. The title of the film is "The Nature of Color," produced by Coronet Films, 62 East Water Street, Chicago, Illinois. The pupils are prepared to see this film through the discussion of the difference between color and pigment. Other questions proposed are: What makes an object look red, green, blue, black or white? How are shades of color prepared? Is it done by adding colors or pigments? What is meant by the additive process? The subtractive process? These questions are answered in the film. The pupils will be discussing these questions after viewing the film.

The film begins with an understanding the pupils already possess. The first frames refer to color and the composition of white light. At this time it is to be pointed out that in using any film or visual aid, care must be exercised to have the pupils' level of comprehension in mind. The visual aid should always begin at the academic level of the pupils. The film is not to be used until the proper academic level is attained by the pupils. The film goes on from the composition of white light to the answers to the proposed questions. Following the viewing of the film, the answers to the questions are discussed. After the questions are answered many problems are proposed as a means of evaluation. Some of these are: If pure red and pure yellow pigments are mixed together, what colors will be reflected? What colors will be absorbed? After the pupils have speculated as to the answer based on the understandings from the film, some pigments are mixed. This is repeated with many combinations including the mixing of all the pigments in a paint box.

THE NEXT step in presenting the meaning of color is carried on through the use of commercially produced 3¼ x 4 slides. The slides are so prepared as to eliminate certain colors of the spectrum. One slide is minus blue, another minus red, another minus green, and another minus violet. The minus red slide is placed in the lantern and pieces of colored paper are viewed. The pupils are able to see that the red paper looks grey in the minus red light. Pupils stand in the light and other pupils describe the colors of their clothing. This is repeated among the other slides.

From this discussion the problem of color

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A Science Fair—Its Organization and Operation

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THE FIRST Greater St. Louis Science Fair, March 29-April 2, 1948, was acclaimed by numerous authorities as the greatest step in educational advancement to be made in St. Louis in many years. The enthusiasm aroused and plans already being discussed by students for exhibits to be entered in the second fair attest to its value.

The idea of fairs is not new. New York City and Pittsburgh (Buhl Planetarium) as well as many state and local academies of science have conducted science fairs for years.

The Providence, R. I., Fair held in April, 1946, however, probably should be credited with the idea of newspaper sponsorship, the first of its kind. Washington, D. C., organized a fair for 1947 and St. Louis for 1948. Each succeeding year the calibre of these fairs has risen, so, improvements are likewise expected for the Second Science Fair in St. Louis; but it is doubtful whether the total number of entries, 1,013, will be surpassed.

Suffice it to say that this first adventure into this field by far exceeded expectations. In fact it would have been considered successful with only half as many entries.

MANY requests have been received for detailed information on the procedures to be followed in organizing and administering a science fair. The writer, who was general chairman, accepted the responsibility for producing this Fair, knowing full well the tremendous amount of work involved. It is not claimed that these procedures are the only ones or the best. However, this information may be of help to others in developing fairs in their own communities. The remainder of this paper will take up the organization and operation of our fair in two phases. The first phase is general organization: financing, space arrangements, sponsorship, etc.; and the second phase is a description of the committees' set-up, their general duties and responsibilities.

Financing

It is essential that sufficient funds be forthcoming to cover adequately all expenditures that may arise. Do not try to start one until you are assured sufficient money will be available for your use. The cost of fairs held to date have invariably surpassed expectations: so do not limit yourselves by specifying a set sum. Be just, however, in stating this possibility so that your sponsor will be prepared for such. Many unexpected expenditures arise at the time of actually staging this fair. This is no time to have to stop and consider whether this or that can be done so as not to exceed the budget. There are worries enough to get the "Show" ready for the "opening date" without having to combat financial obstacles. Expenditures have varied from $500 to $2,500, not counting "awards"—dependent of course on many factors.

Sponsorship

THERE ARE many ideas on sponsorship, but here will be presented the method chosen for the St. Louis Fair. Whether one or more sponsors should be secured will depend on many factors. There are many advantages to single as well as multiple sponsors. It was felt that our "multiple" arrangement was best for our purpose.

a.) Without hesitation it is recommended that your city newspaper (The St. Louis Star Times, for ours) be secured as one of the sponsoring bodies. The publicity value is invaluable. The newspaper will use all its resources in assuring a successful fair, in building up interest among possible entrants, in keeping the public informed of progress being made, and in developing eagerness to attend and see the fine work that will be displayed.

b.) The sponsors can find no better place to display adequately all exhibits than a college or university field house or gymnasium (Washington University field house used). There are many advantages to such a place among which are: the opportunity it offers students to become acquainted

*General chairman and organizer of the Greater St. Louis Fair.

with the faculty, campus, etc., since the later life of many of those having entries will be centered there.

e.) Someone must assume responsibility for directing the tremendous (but very pleasing and finally gratifying) amount of work necessary to stage a fair. Personnel to do the work will be easier to secure if there is a local or metropolitan area organization of science teachers. If not, then a group should be recruited for this purpose. Very few can imagine or visualize the beneficial possibilities of such a project, so there will be many of the "doubting Thomas" type until they actually see one. However, there will always be a "faithful few" who will endeavor to assist so that it may be held. This triple responsibility of sponsorship proved to be an ideal combination to assure success.

Honorary or Advisory Committee

MANY public spirited leaders will lend encouragement and serve in an advisory capacity. Suggested for this are your Chamber of Commerce officers, mayor, school officials, leaders of various educational and scientific organizations and others.

Executive Committee

This should be a very small group, probably three but not more than one, from each sponsoring body which approves plans developed by the Central Committee, expenditures before they are made, etc.

Central Committee

This should be a relatively small group, (too much time is consumed in discussion otherwise), composed of main committee chairmen whose duties are to develop plans for staging the fair. As mentioned above all such plans must be presented to the Executive Committee for approval before being put into practice. The actual production of the fair will be in the hands of this group.

Committees

THE NUMBER of committees is governed by the needs of the particular plans for your fair. The following ones have been suggested for the second "Fair" in St. Louis.

a.) *Resource Committee* shall assume responsibility of making arrangements for advertising, and conducting area meetings of teachers and children to advertise and clarify the whole fair enterprise.

b.) *Promotion Committee* shall aid in general advertising through newspapers, radios, brochures, posters, and application blanks, and will co-operate with the Resource Committee in part.

c.) *Placement Committee* shall make the floor plan of exhibit locations, procure and arrange tables, outlets, aerials, etc., work out a system of coding exhibits and making record cards, and manage the dismantling of the fair.

d.) *Clerical Records Committee* shall have charge of mailing out all registration materials, of enrolling exhibitors at the field house, of keeping all records during judging of exhibits.

e.) *Judging Committee* shall secure the proper number, variety, and calibre of judges, assign judges to respective areas of the field house, seal name cards before judging begins, see that all exhibits are judged before dismissing judges, prepare and present awards, prizes, certificates, etc.

f.) *Student Aid Committee* shall organize student helpers to assist in placement of exhibits, act as ushers, and do "police duty" during the fair (except during judging).

g.) *Awards Committee* shall secure any prizes, awards, certificates, scholarships, etc., desired by the Central Committee.

h.) *Program Committee* shall arrange for the "Opening Night Program" and the "Closing Night or Awards Night Program." It also shall be responsible for the public address system.

i.) *Supervisory Committee* in cooperation with the Student Aid Committee shall formulate a schedule that provides proper supervision at all hours of public exhibition of projects.

Sub-committees

Due to the amount of work evolving from some of the above committees, matters might be expedited and the load better distributed if certain of the committees are sub-divided.

Continued in April issue

Science Clubs at Work

Edited by MARGARET E. PATTERSON
Secretary, Science Clubs of America

• A department devoted to the recognition of the splendid work being done by science club members and their sponsors. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Miss Patterson, Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

Third Annual Junior Scientists' Assembly

KEITH C. JOHNSON*
Public Schools, Washington, D. C

SCIENCE education is at the crossroads. Do we educate only for specialists or only for the masses; or must we face a dual responsibility for both? Science education today, more than ever before, must come to recognize and accept this last point of view. There is growing concern over the apparent failure of our schools to give the general public an appreciation of science's place in our society and over the apparent inadequate preparation we give our potential scientists.

Fourteen members of the Third Annual Junior Scientists' Assembly, representing six states and the District of Columbia, gathered in Washington, D. C., December 30, 1948, to discuss their viewpoints on "Science Education for All American Youth." The points of view expressed by these promising young scientists before the convention of the Science Teaching Societies brought out many suggestions which should be extremely helpful to science teachers. All but one of the young research students are already high school graduates. A few have been out as long as seven years. Therefore, they expressed some very different viewpoints on methods of science teaching; but agreed that a general science education is desirable for all American youth.

*Head of the department of science, divisions 1 to 9, of the public schools, Washington, D. C.

THE PANEL members, ranging in age from 17 to 23, and in professional training from high school senior to Ph.D. candidate, are listed below:

*Janet Mary Jacobson Oak Park, Ill.	BS, MD	U. of Wisconsin, now interning at Med. College of Virginia	Medicine
*Robert Lee Lynch Weston, W. Va.	BS	W. Va. Wesleyan, now continuing study at U. of Richmond, Va.	Physical Chemistry
*Bernard Louis Strehler Johnstown, Pa.	BS	Johns Hopkins, now teaching and studying there	Biology
*Joseph Milton Fox Philadelphia, Pa.	BSChE	U. of Pa., employed by Sharp & Dohme and studying at night	Chemical Engineering
*James Gray McLoughlin Rome, N. Y.	BME	Rensselaer Poly. Inst., employed by DuPont, Wilmington, Del.	Mechanical Engineering
#Ray Reinhart Schiff New Rochelle, N. Y.	AB	Harvard, on leave from Westinghouse Res. Labs., now continuing study at Columbia	Nuclear Physics

The fourteen members of the panel for the Third Annual Junior Scientists' Assembly. *Credit: Science Service.*

Much thinking and discussion went into the planning of the panel program. *Credit: Science Service.*

*Nancy Agnes Durant Alexandria, Va.	AB	Radcliffe, now continuing her studies there	Anthropology
*Jacques Charles Poirier Washington, D. C.	PhB, BS	U. of Chicago, now studying for an advanced degree there	Physical Chemistry
/Anthony G. Oettinger New York City		Harvard	Industrial Management
*David Gordon Shappirio Washington, D. C.		U. of Michigan	Chemistry and Entomology
#Barbara Claire Wolff Flushing, N. Y.		Swarthmore	Genetics
//William E. Atkinson Richmond, Va.		U. of Virginia	Industrial Chemistry
*Ronald Charles Breslow Rahway, N. J.		Harvard	Medical Research
Robert Schaub Huntington, W. Va.		Marshall High School	Medicine

/ honorable mention * winner # grand scholarship winner in annual national Science Talent Search
// winner in annual Virginia Science Talent Search,

Disagreements in viewpoint were resolved in heated discussions at dinner time.
Credit: Science Service.

Dr. Morris Meister, Chairman of the Junior Scientists' Assembly Committee, opened the meeting with an explanation that the Junior Scientists' Assembly was an outgrowth of a resolution of the late Dr. Otis W. Caldwell in his ardent endeavor to encourage youthful scientists. After each member had introduced himself, the panel chairman, Ray Schiff, presented the questions for discussion.

1. What science program should be provided for the 12 years of public school?
   When should science be introduced?
   Should it be taught differently to the average student than to the talented?
   What sciences are essential to the training of the average citizen?

THE PANEL agreed there is need for all students to receive a more general preparation in the field of science education. But they contended that science teachers today are too much interested in the teaching and parrotting of facts; there is too much emphasis on the training of students preparing for college, and too much urgency for students to work toward passing tests at the end of the course.

The panel urged that scientific method rather than fact should be stressed in the teaching of science. They thought some type of general science course designed for everybody is badly needed and this program should begin as early as the junior high school age, if not earlier. It was felt that too much specialized science is taught in our high schools. They said: "We do not have to know thermodynamics to ride a train. We do not need chemistry or physics to know how to use a refrigerator, and yet we need to know enough about these things, about how they work, to live with them."

One of the panel members, who has taught high school science teachers as a fellow in university, levelled a rather serious charge at high school science teachers. Mr. Strehler said: "Among my duties is the teaching of high school teachers. I was singularly impressed with the lack of curiosity they exhibit. They act as if they are taking their science course for the college credit they receive for it rather than for the satisfaction of natural curiosity. They look at the course as a step upward in economic scale rather than for what it will do for them on the intellectual scale."

Pointed questions from the science-teacher-audience put the panel members "on the spot." *Credit: Science Service.*

ALL THROUGH the discussion on the first question posed by the chairman, stress was laid by the panel members on the importance of recognizing science as one of the humanities in the educational program. Mr. Oettinger said: "We ought to specialize in non-specialization in our science education program." Perhaps teachers would not agree to this; but it certainly shows that these young scientists felt the need for a broader preparation in science.

The chairman then turned the discussion to:

2. What should be the science teacher's philosophy—
   toward his class work with students?
   toward his out-of-class work with students?
   toward brilliant students?
   toward slow students?
   toward average students?
   about his own training in science?

The panel expressed many points of view on these questions. The philosophy of teachers: "I taught your father chemistry and what

was good enough for him should be good enough for you" was often mentioned. The panel members felt that times have changed and our methods should be adapted to meet the problems of today. However, they recognized these new approaches cannot be achieved when teachers are hindered by police duties, homeroom assignments, collecting tickets at the football game, low income, etc.

The panel members felt that large classes are not conducive to good teaching; that more equipment and time should be put at the disposal of science teachers. They harped on "bringing the equipment out of the closets and display cases."

THE GENERAL feeling of the panel seemed to be that science teachers could do a great deal more to stimulate interest in science if the students in the class were not all held to the same level of achievement. It was suggested that something be worked out by teachers to allow the fast students to progress according to their ability. Holding able students back to let the average or slow catch up often makes the former lazy, they thought. Wherever possible, greater freedom in meeting the needs of the students rather than holding to rigid prescribed courses was urged.

Mr. Schiff directed the panel's attention to:

3. What emphasis should be put on outside-of-school science training—
   - from parents and other adults?
   - from newspapers, magazines, movies, radio, etc.?
   - from science clubs, junior academies of science, etc.?

There was a decided difference of opinion among members of the panel on these questions. Outside-of-school training often leads to narrow specialization and little understanding about other fields of science, they thought. For instance, "a radio ham knows all about radio, but little about anything else."

Opponents of this stand stated that "interest in some specialization is not learned in school. It must be done in out-of-school hours." They pointed out we live in an era of specialization and therefore some opportunity to specialize should be offered. They agreed science clubs, junior academies of science, science fairs, etc., offer excellent opportunities for the encouragement of specialization. They cautioned that it is a responsibility of the science teacher to point out the values of a broad science education and to discourage too narrow specialization too early.

IN GENERAL the panel criticized the lack of a balanced program. A program of conservation education is missing in many city communities. Many fields of science are neglected while traditional emphasis is placed on chemistry and physics. Meteorology, geology, astronomy, electronics, and atomic energy are areas missing from many science education programs, and yet these fields have a profound effect upon our living today, they insisted.

The general theme of the panel seemed to be that there is a need for a broad science education beginning as far back as the first grade and continuing in increasing complexity through high school graduation.

Coming from gifted high school graduates who are now in science research work, these recommendations should arouse serious consideration from science educators.

The First Junior Scientist's Assembly was held in 1946 during the AAAS convention in Boston under the direction of Dr. Herbert Zim. The Second, directed by Dr. John W. Thomson Jr., was held in Chicago in 1947 at the AAAS. A Fourth is planned for 1949 at the AAAS in New York City. Two summer Junior Scientist's Assemblies have been held on the West Coast: one in San Diego in 1947 and the other in Berkeley in 1948. Dr. Morris Meister has been the chairman of the committee planning these events since their inception.

Automotive Training Books

Irving Frazee, assistant manager of the service department, Ford Motor Company, is the editorial co-ordinator and one of the authors of a new book, *Automotive Fundamentals*, designed to aid students, mechanics and others interested in automobiles in the principles of "how and why" cars, trucks and tractors work. This is the first of a series of ten automotive training books to be published by the American Technical Society.

New Films

The Society for Visual Education, Inc., announce two new series of film strips in science. One series deals with *Foundations of Chemistry*, the other with *Human Biology*. Write for a description of the films.

Aids to Elementary Science Teachers

DWIGHT E. SOLLBERGER

State Teachers College
Indiana, Pennsylvania

The Problem of Learning the Content.

By content is meant the fund of scientific knowledge which the teacher possesses. It is the information that the teacher tries to pass on to the children. By and large it is the basis for passing or failing the children. While the merits of this are debatable, the elementary teacher usually feels so deficient in science content that she is unable to teach science.

MANY teachers now teaching have had few or no courses in science during their teacher preparation. Many colleges now require six hours of biological science and six hours of physical science. This may or may not be followed by a three-credit course in teaching methods in elementary science. Presumably recent graduates from these colleges could be expected to handle science at the elementary level with some degree of success. They should also be able to help teachers in service to set up a science program. Teachers in service might be interested in taking a course in biological or physical science or in teaching methods in science for the elementary school. Those still working for their degrees might well consider this possibility. However, a problem of attitude still remains. No amount of science course-work will prepare an elementary teacher to answer the science questions of the children. No amount of preparation will enable the teacher to exercise an authoritative role in science instruction. Such a procedure violates the very spirit of the science program. In elementary science children learn by observation and experimentation. The wise teacher will guide them to this type of procedure many times when she knows the answer perfectly well. Perhaps it would be simpler to tell the children the answer, but the good teacher realizes that the method is often as important or even more important than the answer. At other times the teacher can go to the same sources for the answer with the children. Such procedures remove the teacher from the pedestal of authority which is a difficult position to maintain. Such a teacher admits not knowing an answer to a question but not a lack of interest in finding the answer. Such a procedure may be difficult to follow in reading, spelling, or arithmetic, but it is the very stuff of which science is made.

In addition to the above suggestions which are primarily matters of attitude, it must be kept in mind the science content for the elementary school is just what the words imply. It is *elementary* science. Unfortunately an attitude of mysticism is often present in the minds of elementary teachers in regard to science. The great accomplishments of science seem like magic when in truth they are simply the result of careful observation and patient work.

Probably most adults with or without courses in science beyond the high school possess the necessary information to teach science in the elementary school, but they lack skill in imparting this information to children. Certainly a person who has finished high school should have a background of information far beyond what we would expect of the children in the elementary school. However, only the skilled teacher can impart this information adequately. The untrained person often attempts long explanations for a question which the teacher knows requires but a simple answer. This satisfies the child until he can comprehend more. The good teacher knows the child may ask questions that would confound the most learned, but she also realizes that the child does not have the ability to comprehend the adult's explanation, nor does he want such an explanation. For example, a six-year old child might inquire as to what makes fire burn without being ready for the story of oxygen, energy, kindling temperature, etc. Teachers having had such adult explanations sometimes fear that they are expected to pass on such information to children. Such fears may be reduced somewhat if one remembers that elementary science is indeed *elementary*.

NEVERTHELESS the teacher will want to have good sources of content close at hand.

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How One Teacher Does It

Some Techniques Presented by

DR. PAUL BRANDWEIN

Forest Hills High School
Forest Hills, New York

WHETHER we teach within the confines of a syllabus or are free to plan the term's work with each group of students, we are faced with the problem of teaching "behavior." It is an important, useful, and interesting unit of experience.

Some learning situations or experiences which have proved challenging to students in my classes are:

1. *Trial and error learning.* a) A square piece of cardboard is cut to form pieces of irregular shape. Each student is asked to make a square from the pieces. After one trial, students are asked to repeat the process. Then trial and error learning is analyzed.

b) A procedure which yields a similar analysis, is "running the maze." A maze diagram, such as can be found in most texts of psychology, is mimeographed on paper. Each student is asked to run the maze with the rubber tip of his pencil. The run is carefully timed by appointed time keepers. The method of learning and the rate of learning are analyzed.

c) A simple maze may be built by students and the rate of learning by rats may be tested.

2. *The nature of habits may be explored by simple experience.*

a) Dictate a passage to the class and ask your students to copy the passage. The length of the dictation is timed. Then dictate the same passage; but this time ask your students not to dot the i's or cross the t's. The length of the dictation is again timed. The experience is then analyzed.

b) A situation analagous to "conditioning" may be explored as follows: Ask your students to make a diagonal / each time you say "write" and strike your ruler on a table. The teacher gives the command and strikes the ruler at a rapid count in the back of the room (so that students do not see him). After the 30th command (two every second) the teacher strikes the ruler only. Many of the students will continue making diagonals to the sound of the ruler even though the command "write" is no longer given. The experience is then analyzed.

3. *Many students insist they work just as well with the radio on or with any noise.* Prepare 30 columns of simple figures (three figures of digits to each column) for addition. Prepare another 30 columns using other figures, but be sure they present the same difficulty.

The first 30 columns are added in a quiet room. Time of completion is carefully recorded. The second 30 columns are added with the radio on—or with some similar disturbance. The times of completion are compared and the data are analyzed.

4. *Conditioning a fish.* Goldfish or tropical fish can be conditioned to come to the upper corner of a tank in response to the flashing of a light, or tapping on the side of the bowl. The stimulus is given at the same time that food is dropped into the corner of the tank.

We should be glad to publish your own contributions to "How One Teacher Does It" under your own name. Contributions can be in any field of science. Old or new, send them in; another teacher may benefit.

ELEMENTARY SCIENCE

Continued from Page 32

Teachers should have a small personal library to which they can refer from time to time. Prominent in this library should be a general science text secured from the local high school or purchased for her by the school. Such a book will answer many questions. The information will have to be modified for children's use, but it will give a teacher a quick source of information. This is not meant to imply that the elementary program should be based on the general science program in the junior or senior high school. Science programs in elementary schools should stand on their own feet.

The teacher should be alert to the vast amount of information appearing in popular magazines, government bulletins, newspapers, and science publications for the laymen. The children will often supply popular magazines or bring in pictures from them.

Another aid to the elementary teacher of

Continued on Page 48

News and Announcements

WORK CONFERENCE IN ELEMENTARY EDUCATION

A Work Conference in Washington, D. C., sponsored by the elementary and secondary divisions of the U. S. Office of Education, has been announced. Problems related to science teaching from kindergarten through the twelfth grade will be considered.

The extension of work through the twelfth year is the result of an elementary conference last year directed by Dr. Bess Goodykoontz, director of the Elementary Division. Glenn O. Blough and Paul E. Blackwood, specialists in elementary science, report that the science group gave special attention to such problems as:

1. Trends and objectives in elementary science education.
2. Plans for organizing a science program of curriculum construction in a large city system.
3. Revision of the science courses of study for one state and for a large city.
4. Use of community resources and other materials in elementary science.
5. How the science program takes into consideration growth and development of children.
6. Planning an adequate in-service training program for elementary teachers.

SUMMER SCIENCE COURSES

San Diego State College, San Diego, California, announces the following three-week summer session courses, August 1-19, designed especially for science teachers:

Science Education in Secondary Schools. A workshop course with consultative assistance from Dr. Philip Johnson, Specialist in Science, U. S. Office of Education.

Science in Elementary Education. A laboratory course designed to assist teachers in developing a science program related to the elementary curriculum.

Field Zoology. A course designed to give a working knowledge of the more common animals in Southern California.

Summer Fellowships

Applications for study during the summer of 1949 under the six-week General Electric Science Fellowship Program are now being accepted by Union College in Schenectady, New York, and Case Institute of Technology in Cleveland, Ohio. One-hundred science teachers will be selected on a competitive basis from nineteen northeastern states. Union College will accept chemistry and physics teachers, but Case only physics. Write to these schools for further information.

Fisher Adds Facilities in Canada

A new extension is being added to the Fisher Scientific Company, Ltd. building in Montreal to increase facilities for filling the laboratory needs of Canadian scientists. Included are a completely new chemical stock and new fireproof vaults for the storage of corrosive and inflammable chemicals.

WRITE FOR IT

Highways of Wire is a new 30-page booklet tracing electricity from the generator to the consumer. For free copies write to School Service Department, Westinghouse Electric Corporation, 306 Fourth Avenue, Box 1017, Pittsburgh 30, Pa.

Progress thru Research is a 12-page publication issued quarterly by General Mills, Inc., Research Laboratories, 2010 East Hennepin Avenue, Minneapolis 13, Minn. Volume 3, No. 2, discusses new starches, some important instruments, and cosmic rays. Available free.

Turtox News, a 40-page service bulletin for biology teachers, is published by General Biological Supply House, 761 East 69th Place, Chicago 37, Ill. Request that your name be put on the mailing list.

N.S.T.A. MEETINGS

The summer meeting of the National Science Teachers Association is being planned for Boston, July 3-4. The December convention is to be in New York City. Watch the journal for complete information.

Meetings of N.S.T.A. Officers and Directors

HANOR A. WEBB, *Secretary*

The officers and directors of the National Science Teachers Association held two business sessions during the meeting of the Science Teaching Societies of the A.A.A.S. in Washington, December 27-30, 1948. These sessions were open to all members of NSTA and invited guests. The attendance on Monday evening was forty-one; on Tuesday evening, forty-nine. All of the officers and most of the directors of the association were present.

Reports from all officers and committees of the association were received. Many details of policy and operation were discussed by the directors, and action taken. A complete copy of the minutes of these meetings is available on request to Robert H. Carleton, Executive Secretary, National Science Teachers Association, 1201 Sixteenth Street, N.W., Washington 6, D. C. A summary of the more important reports and actions follows:

Membership

The total paid membership of NSTA on December 15 was 3,224. Fully 1,000 members, however, had not renewed on that date. This delay, and possible loss of members, is a matter of much concern to the directors.

Finances

The November 1 balance of the association was $21,478.68. Part of this will be used for the operation and the publications of the association; part is for the preparation and distribution of the Packet to members; part is earmarked for use in projects recommended in the association's cooperation with industrial firms. The chief sources of these funds have been the association's members, the National Education Association, and industrial firms.

The Advisory Council on Industry-Science Teaching Relations

This council is composed of ten industrial men and ten science teachers. Dr. Morris Meister, principal of the High School of Science, New York City, is chairman. The council held two business meetings and one program during the two-day session, December 27-28. The program was attended by a large audience. Among the proposals presented by the council to the directors of N.S.T.A. were plans for a careful study of the types of industrial material desired by science teachers, and the ways in which teachers use such material in their classrooms. From the results of such a study industry will be able to prepare better bulletins, booklets, charts, samples, films, etc. Science teachers may learn more efficient ways of obtaining values from these aids to instruction.

It is expected that a very large number of science teachers will be asked for their ideas, and their methods, concerning materials supplied by industry to science classes. If *you* are asked, let your response be prompt and clearly expressed.

The Packet Service

All members of the association are receiving the regular Packets, each containing a number of items of bulletin or booklet material selected by the association's evaluators, and offered by industrial firms and organizations that publish the items. This Packet Service is free to members, and will be continued by the association.

Miss Bertha E. Slye, Director of the Packet Service, visited forty-eight industrial firms during a tour in the fall. She also conducted Industry-Science Teaching Conferences in Buffalo and Detroit. It is possible that similar conferences will be held in other industrial areas, where science teachers may meet industrial experts, and learn how their students may become more familiar with manufacturing processes, and the opportunity for trained workers in industry.

Bulletins in Preparation

Several manuscripts of useful bulletins are in various stages of progress toward publication. The report on the teaching conditions for science in New York State and nationwide (Brandwein-Glenn-Wise) is ready for the printer. Two bulletins on safety, *Teaching Safety through Elementary Science* and *Safety in the Use of Electrical Appliances*, should

be available after several weeks. A discussion of atomic power as it may be taught in schools is in the planning stage. These bulletins will be available to members of the association when issued.

Future Programs

The National Science Teachers Association will meet in Boston in July, 1949; in New York in December, 1949; in Saint Louis in July, 1950. There should be a large attendance of the members of our association at these meetings.

Apparatus and Equipment Committee

A project that may become a very important activity of our association is the development and testing of new apparatus and equipment for science laboratories. Certain apparatus manufacturers have very promising items in blue-print plans or models. The question is, will these devices work, and will science teachers buy and use them? Plans for exploring the needs for new apparatus, and for testing new models, are under discussion by a committee of which Dr. Walter S. Lapp, Southeast High School, Philadelphia, is chairman.

National Science Week

Would a "National Science Week" stir up enthusiasm in your school and community? The suggestion was made by Mr. Lee R. Yothers of Rahway, N. J., that our association sponsor such a week, and offer plans to science teachers who desire them. These plans would concern programs, addresses by students and by adult experts, displays, advertising, news stories, and the like. A committee was appointed to determine the attitude of science teachers over the nation to the benefits that might come from the earnest labor that would be involved.

New Committees

In addition to the new committee to study the desirability of a "National Science Week," others were appointed for new assignments. The more important of these are the Education by Television Committee, the International Relations Committee, and a Committee on Revision of the Association's Constitution, By-laws, and Working Rules. Through these and the present committees, through the full-time services of our Executive Secretary (Carleton) and Director of Membership Service (Slye), and through the personal interest and activity of each member, the National Science Teachers Association plans an ever-growing program for the improvement of science teaching.

STATE SYLLABI

Continued from Page 20

Biology, 1946; A, B, D, E, F, G, H, I.
Chemistry, 1946; A, B, D, E, F, G, H, I.
Physics, 1946; A, B, D, E, F, G, H, I.

South Dakota
General Science, 1938; F, K.
Biology, 1938; F, K.
Chemistry, 1938; F, K.
Physics, 1938; F, K.

Texas
Secondary Science, 1943-4; A, F, I, K.

Vermont
General Science, 1940; A, B, D, E, F, G, H, I, L, M.
Biology, 1940; A, B, D, E, F, G, H, I, L, M.
Physics, 1940; A, B, D, E, F, G, H, I, L, M.
Chemistry, 1940; A, B, D, E, F, G, H, I, L, M.
Geology, 1940; A, B, D, E, F, G, H, I, L, M.
Physiography, 1940; A, B, D, E, F, G, H, I, L, M.
Astronomy, 1940; A, B, D, E, F, G, H, I, L, M.

West Virginia
General Science (7-9) 1937; A, B, C, H, J.
Biology, 1937; A, B, C, D, E, H, J.
Chemistry, 1937; A, B, C, G, H.
Physics, 1937; A, B, C, G, H, J.

Alabama
General Science (7, 8, 9) 1941.
Special studies as adjunct to core curriculum. General Science 7-8-9 a part of group of studies (science-health and safety-mathematics). Biology, physics, chemistry considered to be special studies as adjunct to core curriculum—special interests to be considered as electives in 10-11-12 grades.
Advanced general science, 1941; A, B, H.

Although no effort was made to rate objectively the various state publications, the writers suggest that the state syllabi in elementary science which seem worthy of examination are those prepared by Ohio, Illinois, Florida and Vermont; while the state syllabi in secondary science prepared by New York, South Carolina and Florida seem to be the most complete of the secondary publications.

It is suggested that science teachers who examine these tables may find it worthwhile to procure the publications in which they are interested for the specific information found in them.

SUMMARY

With respect to the information presented in the two tables, the following observations seem justified:

1. The publications for elementary science, for the most part, have been prepared recently. All those analyzed, with the exception of one, were prepared during, or since, 1941.

2. For elementary science little or no emphasis is found concerning visual aids, science vocabulary, laboratory layouts or floor plans, or ways for evaluation.

3. The elementary publications seem concerned chiefly with the more generalized areas of information, such as aims and objectives, units of study and course outlines.

4. The publications for secondary science have not been prepared, in general, as recently as have those for elementary science.

5. The same emphasis, or lack of emphasis, is noted in the publications for secondary science as for elementary science, except that the secondary science publications place more emphasis on laboratory layouts or floor plans, evaluative techniques, and specific teaching techniques.

Keep Us Informed

Why not keep the membership of your state and regional science teachers association informed concerning your officers and programs through *The Science Teacher?* We can list the information in a calendar of events. We want to know your officers so that we may arrange for materials for publication from your membership.

INTERGROUP EDUCATION

Continued from Page 14

The study may make clear that all races have identical genetic make-up.

APPRECIATION for the inventions and discoveries of science may be linked with an identification of scientists by race, religion or ethnic group.

Teachers may wish to place more emphasis upon the biographical background of scientific figures through reading lists and reports.

The contributions and cooperation of scientists from many groups to such a project as the development of the atomic bomb may be used to build a concept of group interdependence in the world of science.

The contributions and cooperation of scientists from many groups to such fields as medicine and industry may be traced.

Science teachers may foster intergroup understanding by helping students to grasp the fact that mankind is one species, *Homo sapiens*, undivided in biological science.

SCIENCE teachers may wish to build sets of criteria by which various textbooks may be judged in terms of opportunities for building intergroup understanding. Life science teachers should be particularly concerned with the treatment of race and heredity. Such criteria could be used either in the selection of new textbooks or in the analysis of textbooks in use in order to decide whether additional instruction need be given.

A Tentative List of Criteria for Judging Science Textbooks from the Standpoint of Intergroup Education

1. Are the cases cited in the treatment of eugenics scientifically sound? Are the euthenic and eugenic factors properly separated in such case studies as the Jonathan Edwards and Roosevelt families?
2. Are the euthenic factors properly differentiated from the eugenic in the study of heredity in general?
3. Is is made clear that external characteristics, such as skin color, shape of head, eye ridges, and nature of hair, do not constitute a scientific basis for the classification

of man into groups?

4. Is it pointed out that all men are genetically the same?

5. Are differences in innate ability treated as individual rather than group? Is it made clear that no "racial" group is innately inferior or superior?

6. Is it pointed out that anthropological research indicates that differences between groups arise largely from long continued environmental factors as well as mutation?

7. In the teaching of the scientific method. is the persistence of stereotypes made clear. Are stereotypes named and placed under critical analysis?

8. Are the scientists who have come from minority groups in our own country or from other cultures given due recognition (Carver, Drew, Noguchi, Agrimonte, Kitasato, etc.)?

9. In the treatment of health, are the effects of restrictive covenants and segregation upon the health of both the underprivileged and privileged groups made apparent?

ILLUMINATION

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the source. By formula, this relationship can be expressed as

$$E \text{ (foot-candles)} = \frac{I \text{ (Candle power)}}{(\text{distance in feet})^2}$$

TO VERIFY this relationship, we can suspend the 75 watt lamp in the black box, and place the foot-candle meter in a normal position (cell facing up) directly under the lamp. All other sources of illumination must be eliminated. It will be noted that as the distance from the filament of the lamp to the face of the photocell is doubled, the illumination in foot-candles, recorded by the meter, is decreased to one-fourth the illumination. Conversely, when the distance is halved, the illumination quadruples.

Now, to calibrate the meter, we must calculate the level of illumination using the above equation, and compare the calculated value with that indicated by the meter.

It has been found by comparison with National Bureau of Standards lamps that the

approximate ($\pm$ 2%) intensity at 0 degrees[5] of a new 75 watt incandescent lamp at rated voltage is 103 candlepower. Therefore, it is only necessary to measure the exact distance (for accuracy, this distance should be at least 10 times the diameter of the source) from the filament of the lamp to the face of the photocell to solve the foot-candle equation. The ratio of calculated foot-candles to meter reading will give a correction factor by which all subsequent readings in the vicinity of this level of illumination must be multiplied. If a foot-candle level greatly different is to be measured, a new correction factor should be found by using a level of illumination in the standardization process comparable to those measurements desired.

A 75 watt incandescent lamp is used since the color temperature of this source at rated voltage is the same as that for which the foot-candle meter is designed to read accurately. If the meter is to be used to measure the illumination of other sources, it will be necessary to multiply the reading by a second correction factor obtainable from Figure 3.

Using these correction factors, it is possible to use the foot-candle meter under most sources of illumination with fairly accurate results.

Transmission and Reflection Factors

THE PERCENT of incident light transmitted by a translucent or transparent material can be determined by the foot-candle meter used in the following manner.

Place the foot-candle meter in normal position under a generally diffused source of illumination. Record the foot-candle reading. Then place the subject material over the photocell of the meter. Again record the meter indication. The ratio of the two readings will be the transmission factor of that material.

The reflection factor of a wall or similar diffusing surface can be found by placing the meter on the wall surface (photocell parallel to and away from the wall), using a diffused source of illumination. The meter indication will be the illumination reaching the surface. Then, reverse the meter (cell facing the wall) and move the meter away from the wall until

5—Directly beneath the lamp, mounted base up.

shadows do not affect the reading and the indication becomes constant (usually 4 to 5 inches). The ratio of the two readings gives the reflection factor of the surface.

Bibliography

J. O. Kraehenbuehl, *Electrical Illumination*, John Wiley & Sons, Inc., New York, New York.

I. E. S. Lighting Handbook, First Edition, Illuminating Engineering Society, 51 Madison Avenue, New York, New York.

Weston Engineering Notes, Vol. 3, No. 2, April, 1948, Weston Electrical Instrument Corporation, Newark, New Jersey.

SCIENCE PRINCIPLES

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the tube toward the ovules at the base. As soon as that growth has started, no other pollen can affect that pistil.

For that reason, Luther Burbank followed the practice of doing his pollenizing early in the morning before the bees started to work. Or, he would open a flower before the petals had opened themselves and sometimes the pistil would be ready to receive pollen. The other, and perhaps the more common way, is to cover a flower with a paper bag before it opens. Then, when the flower is ready to receive pollen, you can be sure that no insect has been there before you. It is not necessary to cover the flower after the pollen has been applied, however, because when pollen has once taken hold, other pollen arriving will have no effect upon the combination.

The result of this cross-pollenization is wide variation in the seedlings which come from the seeds thus produced. In that way, there is a greater variety of plants from which to select those which you think may be useful.

HOWEVER, it is possible merely by going through a bed of plants of one kind or another to discover one or more plants which may have some characteristic which is desirable to perpetuate. For example, at one time Mr. Burbank received an order from a canning company to produce a canning pea with certain characteristics. He was able to produce this pea entirely by selection in three generations. That is, he did not make any

crosses but merely selected those plants which came nearest to the specifications the canning company had made. He then planted the seeds from those plants and again made a selection. After doing this the third time, he found plants which produced enough seeds to start a new variety. That variety is still in use by this canning company in Colorado.

More details of Luther Burbank's work and the methods he used may be obtained in the only book about him which I know still to be in print. It is entitled *Luther Burbank, Plant Magician*, published by Julian Messner Company, New York City.

AUDIO-VISUAL AIDS

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blindness evolves. Through the use of another prepared slide, a color blindness test can be administered to the entire class. Through the use of slides previously noted the pupils are able to see colors approximating the way a color blind man sees them. Through the use of the minus red slide they are able to see colors as a red blind person sees them. Through the use of the minus green slide they are able to see colors as green blind person sees them, etc.

THE MEANING of color is then summarized by the pupils. What do we know about color? Why do colors look different under different types of light? What problems are involved in allowing a color blind man to drive an automobile? How is this knowledge of color used commercially in clothing, interior decorating, colored movies, etc.?

What general principles relating to the use of audio-visual aids have been employed here?

1. Audio-visual aids are not to be used for entertainment; they are to be used as learning experiences.
2. Audio-visual aids are to be appropriate to the concept to be developed.
3. Audio-visual aids are to be suited to the maturity of the pupils.
4. Learning aids are to start with the academic level of the pupils.
5. Before using any film the pupils are to be properly prepared. They should know what questions will be answered in the film.

6. The use of aids is to be followed by a discussion of the answers to the proposed questions.
7. Each aid should lead to new learning experiences.
8. Motion pictures and slides are not to be used to develop understandings when individual experience can be provided. Pictures are not to be substituted for real experiences.
9. No one learning aid is to be considered as the only aid.
10. Audio-visual aids are not to be used as ends in themselves but are to be used as tools of instruction.

What were the results of the use of these aids?

1. Experience was provided for every pupil.
2. Instruction was vitalized.
3. A functional understanding of many concepts was developed.

Care must be exercised when teaching science to use the most appropriate aid. Never use a picture if the real thing is available. Never substitute a seeing experience for a real experience. Never use oral or written symbols by themselves when they can be accompanied by a seeing experience. In order for motion pictures to be most effective in the field of science education they should:

1. Be constructed so as to develop the pupils' power of observation.
2. Provide opportunities for inductive reasoning by the pupils. They should also provide a series of experiences leading to a generalization. The film is not to be a mere series of stated facts.
3. The film must not include too much information.

PROJECT ACTIVITIES WANTED

Project material is wanted by Science Publications, Normal, Illinois, in the fields of biology, physics and general science. One or more projects may be submitted. For manuscripts accepted the amount paid will vary according to the material. Authors should write for information before submitting manuscripts.

THIS AND THAT

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ciety is to build public understanding for experimental medicine. A. J. Carlson, president of the organization, directed attention to the campaign in progress for this month: "Antivivisection organizations will be promoting their legislative proposals throughout the country. It is essential, therefore, that all groups interested in science and health do everything they can to substitute sound and factual information for fantastic propaganda of the antivivisectionists. An enormous contribution to this program would be the arrangement of field visits of biology classes to medical research institutions during the early months of 1949."

New State and Area Directors

Mr. L. F. Bowman—Columbus, Ohio Area.

Mr. James G. Harlow—University of Oklahoma.

Mr. Owen Gothard—South Gate, California.

Mr. H. H. Turner—Phoenix, Arizona.

Summer Meeting

July 4th has been designated as the time for holding N.E.A. departmental meetings. The place is Boston. An interesting program is in the process of preparation. The meeting of the board of directors of N.S.T.A. will be held July 2nd and 3rd.

Hotel space does not permit a full scale convention as yet since 8 to 10,000 would have to be accommodated. So again the N.E.A. meeting will be listed as a limited meeting, planned only for delegates to the N.E.A. Representative Assembly.

As many of you as can should contact your local, district or state association, applying for permission to serve as an N.E.A. delegate. Then you can come a day or two earlier and be present for our N.S.T.A. meeting.

Those of you within an accessible distance who will not tax the hotel facilities are welcome to our meetings even though you are not a delegate.

You are cordially invited to attend and it is our hope that as many of you as can will be present.

ELEMENTARY SCIENCE

Continued from Page 33

science is to be found in the exceptional child at the junior-senior high school level. These talented children can often be relied upon to give demonstrations or set up experiments for the teacher in the elementary grades. It will often provide such talented children with wholesome experiences and enrich their school life.

The high school science teacher may also be interested in providing material, time, and information to the elementary teacher to insure the introduction of science in the elementary school. In some school systems high school teachers have been given time to visit with elementary teachers to give such help. However, with the great emphasis on college preparation in our present-day high schools, care must be taken not to introduce methods and material into the elementary school which are unsuitable to the level of comprehension encountered there.

OTHER sources of information include garden clubs, county agricultural agents, soil conservation specialists, sportsmen's organizations, hobby clubs, local libraries, radio programs, and scout leaders. Such groups will often provide assistance on those topics close to their special interest. The teacher initiates and organizes their efforts, summarizes their contributions, and learns with the children from these helpers in the local community.

The teacher can also learn much content by taking the children on field trips to local industries, the dairy, pumping station, fruit market, the farm, fish hatchery, printing shop, auto repair show, newspaper office, and other interesting places. Science is an integral part of all of these. Such a program depends, of course, upon the teacher being able to develop a cooperative spirit of mutual helpfulness between the lay expert and the school.

More and more industries are coming to realize that they, too, have a stake in education. Such industries often have extensive

educational programs. A one-cent post-card will bring a wealth of science material from some of the nation's greatest industries. The teacher must evaluate such material as to whether it conveys the proper information to the children or whether it represents a form of advertising which is undesirable. The National Science Teachers Association has a committee whose responsibility is to evaluate just such material.

It would seem that if all the opportunities for science instruction are taken into consideration that the teacher has in this area one of the most unusual opportunities in education today. Much of the material is so fascinating that we can hardly recognize it as material for study, since study so often means something unpleasant and tedious.

The Problem of Textbooks and Courses of Study.

SINCE science is a new subject for the elementary school, there has been a dearth of good textbooks in this field until recently. At the present time, however, some of the most attractive textbooks in the elementary program are science textbooks. While the science program should not be a textbook program, it must be recognized that many factors will cause the teacher to rely upon textbooks. In general several textbooks are superior to a single set; and using the textbooks for sources of information to aid in the solution of a problem is superior to reading for the sake of reading alone.

Textbooks should be chosen for readibility and accuracy, both in work and illustrations, and for consistency with the best educational philosophy. Some textbooks emphasize the exotic over the local until the child scarcely knows his own environment as well as a far distant one. The textbook too often becomes the final authority in such situations, whereas the objects themselves should constitute the final authority.

Book Shelf

TECHNIQUES OF OBSERVING THE WEATHER. B. C. Haynes, Chief, Observations Section, U. S. Weather Bureau. John Wiley and Sons, Inc., N. Y., 1947. 246 pp. 13.5x21 cm. 98 illus. $4.00.

In *Techniques of Observing the Weather* a top job is done by the top man in weather observation in the United States in giving the high school or college student a concise, accurate and easy to understand explanation of the factors involved in weather, their measurement and interpretation. Though the text is simply written, it is very thorough and will give either the student or the hobbiest a basic working knowledge of the use of instruments, making observations, and interpretating data. Because of the requirement of uniformity in weather observing, the text follows closely the various U. S. Weather Bureau instructions on weather observation.

The text is well illustrated to make clear the thought and has numerous references and tables.

SCIENCE TEACHING. Arthur G. Hoff, University of Redlands, California. The Blakiston Company, Philadelphia, 1947. 303 pp. 14x21 cm.

Drawing from a rich experience in teaching and in the training of teachers Van Hoff presents in *Science Teaching* a much needed up-to-date summary of functional information of value not only to these preparing to teach but to those who want to keep abreast of modern methods and their use. The book covers the field well. Following an introduction which gives the "Mission of Science in Education," it deals with science content in the secondary school, discussing its selection and organization in several curricula of junior and senior high school level.

The unit plan for teaching is presented along with its administration as a proved method which may be varied according to the experience of the teacher. The advantages and disadvantages of other methods are also discussed.

Specific techniques and such supplementary factors as teaching aids, field trips, and science equipment are also included.

The discussion is based not only on experience but on the findings of research in the field. A number of references are given with each unit for further exploration in the field.

LET'S LOOK INSIDE YOUR HOUSE. Herman and Nina Schneider. William R. Scott, Inc., New York, 1948. 40 pp. 20x24 cm. 45 illus. $1.50.

Children will be fascinated by this book which helps them to understand such common problems as what makes the electric light burn, where does the water go from the wash room, how do we get power to run sweepers, etc. The explanation is simple and easy to understand by the eight to ten year old child. In many cases activities are suggested—things to try, things to do—to give experiences to aid understandings. The book is excellent for use in the elementary school. It is written by teachers who understand how children learn.

SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY, Eighteenth Edition. Enrich Hausman, Polytechnic Institute, Brooklyn, New York. D. Van Nostranc Company, New York, 1948. 796 pp. 14.5x23 cm. 500 illus. $4.80.

Swope's Lessons in Practical Electricity, eighteenth edition, is a completely rewritten book. It retains the same excellence of preceding editions but has been brought up-to-date in line with current theory and practice. Space for new material has been obtained by combining some of the lessons of the earlier editions, such as those of magnets and magnetism of voltaic cells, and chemical effects of electricity. New material includes the current concepts as to the structure of matter, the behaviour of electrical particles, and two added lessons on radio. Among items included as new in radio are multi-electrode tubes, facsimilie transmission, frequency modulation, and television. There is also a study of loran and radar signaling. Many experiments and problems are explained to give the student a working understanding of principles. The book will be found very useful as text on the college level, also a very practical and easily understood treatise for those desiring to extend their knowledge in the electrical field.

LAMBERT'S HISTOLOGY—Second Edition. Revised by Helen L. Dawson, University of Iowa, Ames, Iowa. The Blakiston Co., Philadelphia, 1948. 696 pp. 15x23 cm. Illus. $6.00.

The revised edition of this carefully written and scholarly book is designed to meet the needs of beginning students in histology. Basic concepts are stressed such as fundamental morphological characteristics and the functional significance of cells, tissues, and organs.

Where there is a difference of opinion in regard to structure or function, the generally accepted one is used. Other views are left to the discretion of the teacher.

An important feature of this revision is the addition of methods of identification of unknown tissues. This helps to eliminate confusion among beginning students when faced with a practical problem in this area.

The illustrations in the book are well chosen to help make clear the textual matter.

THE MACHINERY OF THE BODY—Third Edition. Anton J. Carlson and Victor Johnson. University of Chicago, The University of Chicago Press, Chicago, 1948. 639 pp. 15x23 cm. 220 illus. $4.50.

The latest edition of this pre-eminent book dealing with the whole field of physiological phenomena now has added the newer knowledge growing out of the research stimulated by World War II.

Included is such important developments as employment of blood banks, transfusion, and the use of new drugs and radio-active elements in medicine. There is also new material on pernicious anemia, cancer, and nervous disorders in relation to body functioning.

The text is quite thorough, yet easy to understand. It is particularly suited to the introductory college course in physiology but will be found useful as high school reference.

AN INTRODUCTION TO ORGANIC CHEMISTRY—Third Edition. Ira D. Garard, Ph. D., Rutgers University, John Wiley and Sons, Inc., 1948. 396 pp. 14.5x23 cm. $3.50.

This book, as with the earlier editions, provides for a one semester introductory course in organic chemistry, but can be used for a more extended study. The more fundamental reactions are emphasized.

The major change in revision centers around hydrocarbons, although more attention is given

azeotrophy and the nature of valence. There are discussions of nitroparaffins, aliphatic sulfur compounds, and polarized light.

A series of experiments is included in the back for laboratory practice.

ELEMENTARY INDUSTRIAL ELECTRONICS. William R. Wellsman, Co-Chairman, Radio Department, George Westinghouse Vocational School, New York City. D. Van Nostrand Co., Inc., New York, 1948. 371 pp. 14x23 cm. Illus. $3.20.

Elementary Industrial Electronics explains in easily understood language and in simple terms the basic principles involved in electronic equipment now in use. It is well suited to the beginning student and those in the electrical or maintenance field who want a basic understanding in this area.

Included is a discussion of the important types of vacuum tubes and their application, hot cathode gas-type rectifiers, mercury pool rectifiers, industrial high-frequency heating, electronic control of motors and resistance welding, photo electric devices and electronic lamps.

This book is well adapted as a text for a beginning course. The principles are clearly presented; diagrams are used extensively to clarify the textual material; seventeen simple experiments, using accessible and low cost equipment, are included. Questions are found at the end of each chapter. The bibliography will be found particularly helpful.

AMERICAN HIGH SCHOOL BIOLOGY. Charlotte L. Grant, H. Keith Cady, and Nathan A. Neal. Harper & Brothers Publishers, New York, 1948. 888 pp. 16.5x24 cm. $3.28 list.

The basic principles of biology are presented in relation to the students' own experiences. From these he is lead to see his own opportunities and responsibilities, and to understand his place in the wider scheme of things. Emphasis is always on the constructive, practical application of biology. The book is well-written, and is divided into ten major units and forty chapters. Up-to-date information on heredity, eugenics and processes of reproduction is presented in a straight-forward manner. The book contains many well-selected illustrations, including a series by Miss Berenice Abbot, that make the interpretation of the text more understandable and effective. Scenes from the Encyclopaedia Britannica Films will help the teacher choose appropriate and effective films. Scientific terms are italicized and appear along with others in the 28-page glossary where definitions and pronunciations are given. Other teaching aids are found at the close of each chapter and each unit in the form of vocabulary tests, thought questions, a summary, projects, and a bibliography. The book contains an excellent section on occupations in biology and a 22-page index. It would serve well either as a basic class text or as a reference book.

ADVENTURES WITH ANIMALS AND PLANTS. Elsbeth Kroeber and Walter H. Wolff. D. C. Heath and Company, Boston, 1948. 600 pp. 17.5x24 cm. $3.20.

This book is the successor to *Adventures with Living Things*. The new book is very interestingly written, quite teachable, with a pleasing modern format, and easy-to-read double column pages. It is divided into ten major units, each presenting a major topic characteristic to the field. Units are further subdivided into problems (chapters) titled in the form of a key question. Paragraph headings are in boldface type, designed to tell the student what he should learn from the section. Special biology terms are italicized and defined where they

first appear. Likewise, phonetic pronunciation of numerous terms are included. The many well-selected illustrations — photographs, drawings, graphs, etc.—used in the text give basic understandings and informations, and are an integral part of the context. The questions, exercises and projects at the end of each problem will be of much assistance to the teacher, and in turn will serve as a valuable review for the student. The application of the scientific method is stressed throughout the book. Additional readings from both books and magazines are provided for each unit. The detailed eighteen-page index indicates where definitions may be found in the book. The text would be suitable both as a library reference and as a basic class text. A workbook and laboratory manual, and a teacher's manual are in preparation.

HOW TO LIVE LONGER. Justus J. Schifferes, Recently Associate in Hygiene, Columbia College; formerly instructor in Health Education, Teachers College, Columbia University. E. P. Dutton and Company, Inc., New York, 1949. 255 pp. 15x21 cm. $3.00.

This is a book in direct, simply written, nontechnical language, based on the most recent findings of public-health and medical authorities and on the latest U. S. Government statistics. From these records the author shows what are the principal causes of death among our people today. He points out the usual course of these dangers, tells how to guard against them, and identifies the danger signals for which to watch. By giving an accurate account of the disease hazards to which the people in the United States are most likely to succumb and by detailing the pertinent facts concerning these diseases the personal responsibility which each one holds for his own life and good health is demonstrated. The author does not attempt to diagnose ills or prescribe treatments. In his own words, "*How to Live Longer* is the result of reactions I had in the years when I was editing *Modern Medicine* and sat at the crossroads where medicine and propaganda met. I felt there ought to be more attention given to getting life-sustaining facts across to people who are blissfully unaware of the most elementary medical truths. This is the field now called health education. It might be called preventive medicine in action." B. H.

FOUNDATION OF MODERN PHYSICS—Second Edition. Thomas B. Brown, Professor of Physics, George Washington University. John Wiley and Sons, Inc., New York, 1949. 391 pp. 14x23 cm. 181 illus. $5.00.

For those who would teach modern physics in a most interesting setting of experiment and modern applications, *Foundations of Modern Physics* will be most valuable. Originally developed as the fourth unit of a two year college physics course, the text has grown until it may well be used for a full year.

CHATS

Continued from Page 18

both infinitesimal and infinite.

The ability to marvel comes early in the intellectual growth of youth. Some science teachers cultivate this instinct, but others stifle it. Do imaginations grow, or shrivel, in *your* classes?